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Inadequate Returns of Fall Chinook Salmon To the Quinault National Fish Hatchery 1983 Progress Report

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INTRODUCTION

The Olympia Fisheries Assistance Office (FAO) reported in 1982 (Wampler 1982) on the persistent problem of inadequate returns of fall chinook (FC) broodstock to the Quinault National Fish Hatchery (QNFH). That report reviewed factors thought to be contributing to the broodstock problem. The most suspect factors presented were: (1) the successive introduction of eight different imported FC stocks (in attempts to satisfy the hatchery's production goal) which apparently led to increased straying and a shift to an earlier time of return; (2) over-harvest in the Quinault tribal terminal fishery; and (3) failure of some proportion of the spawners in Cook Creek, the hatchery stream, to enter QNFH. Another suspected factor, high rate of harvest in ocean fisheries, was not well documented.

Two recommendations were made in the 1982 report. One recommendation was that the Tribe reduce its FC fishery to ensure a significantly increased escapement of fish bound for QNFH. Quinault Tribal fisheries staff were not convinced that reduction in tribal harvest would significantly increase returns to Cook Creek. They thought straying was so significant that the fish which escaped the terminal fishery would remain in the mainstem. The other recommendation was that the U.S. Fish and Wildlife Service construct and operate a temporary weir trap on Cook Creek to increase success in capturing FC broodstock. A weir trap was constructed and fished as the 1982 FC spawning run began.

This progress report presents the results of the Service's efforts in collecting broodstock in 1982. It also reviews other activities of the Service and the Quinault Tribe relative to the 1982 FC run. The impact of ocean harvest and other fisheries on FC from QNFH is discussed. Circumstances that adversely impact FC production at QNFH are described. And, finally, report conclusions are summarized.

METHODS

Weir Trap

Based upon results of the 1981 spawning surveys on Cook Creek a suitable site for construction of a weir trap was selected. The site was established at about creek mile 3.3, which is accessible by gravel road and is downstream of the creek reach found to contain the majority of FC that remain in the creek. While constrained with very limited funding, the FAO weir design incorporated the most recent design improvements made by Washington Department of Fisheries (WDF) in its adult trapping research (Blankenship and Tivel 1980). Large four-legged wooden horses were spaced along a diagonal line spanning the 65 foot width of the creek. Horses were connected by 4 x 6 inch wood stringers and the stringers, in turn, supported aluminum panels that served as the fence to prevent passage of larger fish. The panels, consisting of welded 1/4 inch aluminum bar, were 6 feet long by 2 feet wide with 2 inch spacing between bars. One-quarter inch bar thickness significantly reduced the weir's resistance to creek flow. The 2 inch gap between bars provided relatively easy passage for jack salmon. A larger wooden live trap, supported by two of the horses, was positioned near the stream bank adjacent to the access road. Within the trap a short flume led migrating fish into the trap interior.

The weir trap was equipped with gasoline-generated electric lighting for night operation, a walkway surfaced with roof shingles to provide safe footing, and a safety hand line. Horse platforms were weighted with rock and gravel bags for balast, and additional support was provided by metal wire ropes clamped to large trees on both stream banks. Stream banks were lined with sheet polyethylene and then protected by rows of gravel bags to prevent bank erosion. Metal chicken wire was laid on the stream bed under the horse legs and then covered with gravel bags to prevent bed washout.

When the weir trap was fished, adult chinook salmon were hand-netted from the live trap and quickly carried to a nearby flatbed truck where fish were placed in a fish transport box. Other species of salmon were released on the upstream side of the weir.

Radio Tagging

An attempt was also made to determine the final destination of radio-tagged, Cook Creek origin FC. Final destination of these fish during the spawning migration is one of the least understood periods in their life cycle (Wampler 1982). Preparations were made to net FC at the upstream end of the tribal net fishery in the Quinault River, insert radio transmitters in a number of fish and then monitor their movements and ultimate destination.

Dart Tagging

The Quinault Department of Natural Resources (QDNR) worked with tribal fishermen in the Quinault River to insert dart tags in FC entering the fishery. Their objective was to determine whether or not FC are milling at the mouth of the river and, if so, whether these movements are tidally influenced. Such behavior would subject early run fish to a greater harvest rate before

they move past the fishery. Dart tagging was performed on FC caught at a point about 100 yards upstream of the river mouth. Netted fish were quickly removed from the net and placed head down in a large plastic can. While held in this manner they soon became docile enough to allow tag insertion. Dart tags recovered in the fishery or elsewhere were returned to QDNR along with the location of their recovery.

Quinault River Redd Surveys

The QDNR performed two helicopter surveys of the lower Quinault River to count FC redds and fish. Surveys began in the vicinity of the river mouth and continued up to Lake Quinault and beyond. As in the past, visual observations were tape recorded and later transcribed for use.

An acoustical fish counter, expected to be in service for the fall salmon runs, was still subject to interpretation error at the onset of the fall runs and was not used.

RESULTS

Broodstock Capture

The weir trap was completed and ready to fish in late August, 1982, prior to the beginning of the FC run in Cook Creek. There was relatively little discharge in the creek through September. The first chinook jacks appeared at QNFH in mid-September (Table 1). Information on actual dates that FC enter QNFH is not recorded. The data in Table 1 are days fish were killed for taking and fertilizing eggs; however, they do indicate when hatchery entry peaks occurred. As observed in 1981, and during previous FC runs, sharp increases in creek discharge stimulated increased FC movement to the weir trap and, in the case of jacks, to QNFH.

Table 1. Number of fall chinook that returned to the QNFH racks, fall 1982. Data is listed by dates fish were killed for spawning. Fish captured at the weir trap were included and did contribute to these figures.

Date	Adult Females	Adult Males	Jack Males
Sep 15			1
21			1
Oct 7			5
8	5	3	166
11	1		1
13	15	11	3
19	15	1	
22	6		
25	21	23	56
28	20	59	38
Nov 2	21	2	3
4			
8	11	1	4
9	3	16	
18	4	5	
19		1	
24	2	9	
26	1		
29	3		
Dec 7		1	
Total	128	132	278

The first adult FC capture in the weir trap, one female, occurred on September 11. The next captures did not occur until October 6 when 6 adults were taken. Twenty-three adults were taken the next day. During the next 9 days a total of 8 adults were captured at the weir trap. It was observed that adult salmon must be removed quickly from the trap to prevent self-injury.

A Cook Creek spawning survey on October 19, from the weir downstream 1/4 mile, revealed the presence of 12 fresh FC redds and a number of spawning FC adults and jacks in the vicinity. On October 21, the QNFH manager removed some of the weir panels and ceased to fish the weir trap due, in part, to the reduced staff at QNFH. That day heavy rainfall began and by the next day the creek discharge had increased dramatically. This resulted in an increase in entrained debris, particularly alder leaves, which required hourly removal from the weir panels. Salmon were observed migrating past the weir in large numbers. The decision was made to discontinue fishing the weir trap in view of the combined circumstances. It was hoped that all FC migrating past the weir would continue to move the remaining 1.4 miles up to the hatchery as the freshet continued. Cook Creek discharge remained high until November 3.

Thirty-eight of the 260 adult FC that returned to the hatchery were captured at the weir trap. These fish are included in numbers presented in Table 1. A total of 128 female FC were spawned at QNFH. Using a mean fecundity of 5500 eggs per female an estimated 704,000 eggs were obtained. The existing FC production goal of 1.75 million smolts, and mean fish losses over the culture period, require that more than 500 females be spawned annually. The 1982 broodstock shortfall, therefore, was about 375 females. The shortfall of males, although not as critical, was also very large.

The Cook Creek FC spawning run peak occurred, as in 1981, during the last week of October. Two spawner surveys below the hatchery indicated relatively few FC spawned below the hatchery in 1982.

Radio Tagging

The FAO, QNFH, and Quinault tribal fishermen worked cooperatively in planning to radio tag FC in the lower mainstem Quinault River. A tribal fishing site at the upper end of the net fishery, about 1/4 mile upstream of the Chow Chow Bridge, was selected for set netting. Appearance of FC in tribal nets on the upper fishing grounds was used to determine when netting for radio tagging should begin. There were so few FC appearing in those nets, during the weeks when QNFH fish are normally migrating past the fishery, that it was never obvious when to begin fishing. Efforts to capture FC were made on September 7 and September 10 but none were caught or observed. Later in September, it was concluded that too few Cook Creek FC were available to justify further radio tagging effort, and this phase of the study was cancelled. Also, at that time only about one out of five coded wire tags recovered from FC in the fishery were of QNFH origin. This low incidence was further justification for cancellation.

Dart Tagging

Delays in obtaining required tags and equipment resulted in a late start for the QDNR dart tagging study. Twelve FC were tagged from September 9 to 11. An additional 26 FC were tagged from September 16 to 19. Of the 38 FC that were dart tagged, 16 were recovered in the tribal fishery, and most of those were netted at fishing grounds near to but upstream of river mile 2. One tag was recovered from a fish caught in the river at the mouth of Cook Creek, at about river mile 16.5. One tag was recovered at QNFH.

Quinault River Redd Surveys

Helicopter surveys were performed on October 14 and November 23. The first survey was conducted after peak catches occurred in the FC tribal fishery and preceded the peak of the run to QNFH. The second survey occurred after the FC tribal fishery was over and at the end of the run. Survey results are presented in Table 2. On both surveys numbers of redds and live adult FC upstream of the mouth of Cook Creek greatly exceeded counts below the mouth of Cook Creek. These numbers are subject to some error, particularly counts of live fish due to their panicked swimming response to the helicopter (personal communication, Larry Parker QDNR).

Table 2. Quinault River Helicopter Surveys for FC and Redds. From QDNR Files.

River Reach	Redds		Live FC		Dead FC	
	Oct 14	Nov 23	Oct 14	Nov 23	Oct 14	Nov 23
Mouth to Chow Chow bridge	1	3	0	1	0	0
Chow Chow bridge to Joe Creek	9	7	2	3	0	4
Joe Creek to Cook Creek	10	1	9	0	0	0
Total	20	11	11	4	0	4
Cook Creek to Boulder Creek	4	19	8	1	0	0
Boulder Creek to 101 bridge	47	101	77	205	2	0
Total	51	120	85	206	2	0

Quinault Tribal Fishery

The tribal catch of FC in 1982 is presented, by month, in Table 3 along with similar data recorded since 1950. The total catch of 5,533, was only slightly increased over the previous year's catch. The number of fishing days per week, 3.5, for statistical weeks 32 through 38 were virtually unchanged from 1981. The rate of fishing during this period was higher prior to 1981. During weeks 32 to about 39, number of open fishing days are based on FC management objectives (Larry Gilbertson, personal communication 1983). From about week 39 on, number of open fishing days was guided by coho salmon management objectives although the peak in FC catch came in week 41. A comparison of tribal weekly fishing effort, FC catch, and coho catch is presented, by 1982 statistical week, in Table 4.

Coded Wire Tag Returns

Fish from 5 coded wire tagged (CWT) groups of FC released from QNFH were recovered in the 1982 tribal fishery (source, QDNR 1982 computer files). The estimated total contribution to the FC fishery, based on expansion of recovered CWT fish, was 1,571, or 28.4% (Table 5). In recent years the QNFH contribution has declined from 73.6%, in 1977, to 26.7% in 1981. QDNR staff have observed that during this same time period numbers of non-hatchery, or wild, FC have increased almost every year. The Quinault Lake facility contribution began in 1981 at 1.7%, and increased to 5.1% in 1982. These Quinault Lake facility contributions were from only one year class (1978 brood), whereas the QNFH contributions were from three year classes.

Tribal Hatchery FC

Data on recovery of CWT FC from the Tribe's Quinault Lake hatchery is too limited to permit unbiased comparison to QNFH FC survival rates at this time. Only two CWT groups' recovery data for three and four year olds is available. One of these groups was not suitable for comparison purposes because expected survival was increased through vibrio vaccination prior to release.

Table 3. Quinault Tribal Catch of FC in The Quinault River. Monthly Data from QDNR Files.

	MONTHLY CATCH					
Year	August	September	October	November	December	Annual Total
1950	8	455	4123	228	368	5182
1951	23	285	1327	304		1939
1952		31	2893	2354	2	5280
1953	1	250	725	321		1297
1954	100	419	1109	281		1909
1955		49	986	137	14	1186
1956	50	326	2007	124		2507
1957		94	1851	396	3	2344
1958	10	264	2201	682	23	3180
1959	10	169	1418	218		1815
1960	100	558	1727	147	5	2537
1961	100	567	1134	80	2	1883
1962	100	382	798	519		1799
1963	40	358	2089	357	9	2853
1964	100	517	669	108		1394
1965	25	613	2847	141	29	3655
1966	25	366	3156	215		3762
1967	40	507	1296	220		2063
1968	300	820	673	59		1852
1969	50	567	263	68		948
1970	75	356	1290	13		1734
Mean	55	379	1647	332	22	2434
1971	450	986	480			1916
1972	500	1459	489	33		2481
1973	80	302	1088	199	7	1676
1974	15	588	1155	715		2473
1975	22	344	1059	171	4	1600
1976	227	1262	1622	345	7	3463
1977	138	3185	2603	212	8	6146
1978	176	3769	2187	871	38	7041
1979	614	2705	3373	380	26	7098
1980	762	2541	1482	381	2	5163
1981	457	3128	1709	164	5	5463
1982	548	3057	1827	101		5533
Mean	332	1944	1589	298	8	4171

Table 4. 1982 Tribal Catch of FC in the Quinault River. Coho catch is also presented for comparison. Data taken from QDNR files.

Statistical Week	Week Starting Date	Weekly Fishing Effort	Total FC Catch	Total Coho Catch
	Aug			
32	1	47	17	8
33	8	38	31	7
34	15	56	58	11
35	22	119	311	11
36	29	80	164	14
	Sept			
37	5	114	462	105
38	12	185	732	340
39	19	182	876	499
40	26	193	954	372
	Oct			
41	3	251	964	1532
42	10	184	179	1091
43	17	253	324	1683
44	24	280	345	3248
45	31	229	78	1136
	Nov			
46	7	215	28	301
47	14	158	10	208

Table 5. Compared Tribal FC catch and contributions from QNFH and the Quinault Lake pens facility.

	Year (19-)					
	77	78	79	80	81	82
Tribal Catch	6153	7229	7176	5324	5458	5533
Estimated QNFH Contribution: Number	4527	4683	4570	2971	1459	1571
% of Total Catch	73.6	64.8	63.7	55.8	26.7	28.4
Estimated Lake Pens Contribution: Number	0	0	0	0	93[a]	283[a]
% of Total Catch	0	0	0	0	1.7	5.1

[a] Estimated catch of two CWT groups, 1978 brood only.

DISCUSSION

Broodstock Capture

The estimated shortfall below the QNFH FC broodstock goal since 1973 has ranged from 56 to 1,025 fish, with a mean of 708. The 1982 shortfall was about 800. In reviewing the results of the 1982 weir trap operation it became apparent that without a concurrent reduction in the tribal net fishery the trap operation could not provide adequate returns to meet the QNFH FC production goal. If the weir trap is to be used in the future there should first be data to clearly indicate that a significantly higher proportion of QNFH FC has escaped the terminal fishery.

Dart Tagging

There were insufficient data collected from the initial dart tagging work to draw any conclusions on suspected milling behavior during the early portion of the run. Hopefully, an expanded dart tagging study will be performed in 1983. A well planned and executed study of tag recoveries compared to fishing effort during several FC fisheries should provide the best estimate of exploitation rate.

Spawning at QNFH

Several problems exist in the FC spawning operation at QNFH. Spawning must be performed in the open. Eggs in buckets are susceptible to precipitation that can lead to premature water hardening and mortality. Normally there is no lack of precipitation at QNFH. Without use of the uncompleted spawning building additional personnel are required and, as a result, spawning has frequently taken place without sufficient people to perform the task efficiently. (personal communication, Daniel Davies, Assistant Hatchery Manager).

FC Distribution in 1982

As in previous years, knowledge of FC migration behavior in the lower Quinault River and tributaries in 1982 was limited by high flow and turbidity. With only two completed helicopter surveys of Quinault River spawning an escapement estimate was again impossible. The greatest concentration of FC spawners and redds observed anywhere above the fishery was found in the mainstem between Boulder Creek and the Lake Quinault outlet (Table 2). This is generally the river reach assumed to receive the majority of wild spawners. The redds and spawners seen on November 23 apparently were wild FC. Observations made by staff from QNFH, the tribal hatchery and FAO all indicated that relatively few FC spawned between the upper limits of the fishery and the mouth of Cook Creek.

QNFH FC Timing in the Fishery

During the last five years the contribution from QNFH, based on CWT recoveries, has begun in statistical week 32 or 33, and ended between week 40 to 48. The peak contribution has occurred between week 36 to 39. The percent

contribution on a weekly basis has varied widely, but has tended to drop sharply after about week 41.

Data from CWT recoveries has also shown that the majority of FC caught in August and early September are of QNFH origin. Historically, few FC were caught in August (Table 3). The mean number of FC caught in August before QNFH contribution began (1950-1970), compared with the mean number after QNFH contributions began, shows a 600% increase.

While numbers of FC released from QNFH increased from 1974 to 1977, the estimated contribution to the fishery decreased significally. Since 1979, there has been a general decrease in FC released from QNFH because of inadequate broodstock. This trend will continue, given the existing exploitation rates and the FWS ban on the importation of eggs. If the current QNFH FC production goal of 1.75 million smolts is to be maintained, and all other policies both of the Service and the Tribe are left unchanged, it is unlikely that FC broodstock requirements will be met. If the fishery is adjusted it should be done on a one-year trial basis, as recommended in the 1982 report. The most appropriate period for an adjustment in the fishery is the first weeks when QNFH contribution is greatest. The present rate of fishing in August, 3.5 days per week, has apparently been ineffective for allowing adequate escapement.

QNFH FC Production

One alternative to trying to increase FC adult escapement would be to reduce the QNFH FC smolt production goal. There are existing problems in culturing FC at QNFH that would be reduced or eliminated by significantly reducing the production of FC. The principal problems are insufficient hatchery flow-through water during the dry season, and insufficient rearing space for all species, particularly during the period July through September. During the summer months only about 15 of the 30 hatchery ponds can be used due to insufficient water. Water reuse through the FC rearing ponds in summer is now standard procedure to take fullest advantage of the limited water supply. The first FC plant is, out of necessity, made in July when fish size is about 50 to the pound. This smaller release size can be expected to result in reduced survival to adult fish. Stress due to water temperature elevation, and disease outbreaks are both linked to inadequate flow-through water and overcrowding in summer months.

One possible solution to the annual problems of inadequate water supply and rearing capacity is to construct two rearing ponds immediately downstream of QNFH. The ponds, of concrete construction with gravel bottoms, would rely on additional reuse of QNFH flow-through water. Incorporation of these ponds into annual QNFH production management would permit extended rearing of FC before release, resulting in greater survival and contribution to ocean and terminal fisheries. Production of other species reared at QNFH would also benefit from reduced crowding.

Research in California on use of the artificial attractant morpholine indicated possible potential for improvement of salmon homing to hatcheries (Hassler and Kucas 1982). Treated groups of marked coho and chinook salmon were exposed to 5×10^{-5} mg/l of morpholine for 17 days prior to release. Morpholine was later metered into the fish ladder during their spawning

migration. Return of treated coho was significantly greater than that of control groups. Initial returns of treated chinook, however, were not significantly greater than for control groups. The chinook experimental group had significant disease problems which may have affected survival and masked effectiveness of the treatment.

Release Size and Survival

In a recent FAO report on QNFH CWT results (Hiss and Paiya 1982), FC survival for five 1973 brood year tag groups was determined. Additional CWT results for QNFH FC have been made available by the WDF (computer files, revised 1983). Twelve additional tag group analyses are presented in appendix tables 1 to 12. The combined groups include all CWT FC released from QNFH from brood years 1973 to 1976. Two of the 17 CWT groups were non-coastal stocks that had a mean smolt to adult survival rate of 0.16%. The remaining 15 CWT groups were coastal stocks from Cook Creek, and Willapa, Nemah and Hoh Rivers that had a mean smolt to adult survival rate of 0.96%. A number of assumptions must be made about the accuracy of these survival estimates (Hiss and Paiya 1982); however, they are regarded as the best available information on QNFH FC production. Linear regression analyses were performed on these 17 CWT groups for (1) percent survival vs. size at release, and (2) percent survival vs. day of release. The first test showed a correlation of $r=-0.69$. The second test gave a similar result, $r=0.70$. Both correlations were statistically significant at the 1% level (Snedecar and Cochran 1972). These results confirm that there is a direct relationship between delayed release and FC survival to adult and that delayed release is the preferred procedure.

Juvenile salmonids reared at low densities have also exhibited higher survival rates. Another strategy for increasing adult returns to QNFH might be to reduce juvenile rearing densities while delaying release dates. These program changes could be accomodated by reductions in one or both of the other two species reared in summer and fall (coho and winter steelhead) or by reducing the broodstock requirements and production goal.

Ocean Harvest

Hiss and Paiya (1982) determined that a majority of the 1973 brood year FC from QNFH were caught in Canadian fisheries (mean 51.2%). In comparison, the Quinault tribal terminal fishery caught far fewer (mean 19.4%). For this report a similar analysis was performed for brood years 1974 to 1976. Calculations of catch distribution for 12 additional CWT groups of FC are compared in table 6. Fish that escaped the terminal fishery and were not counted at QNFH are not accounted for in either analysis. In this larger sample the Quinault terminal fishery caught a mean 38% while the next largest catch catagory was Canadian fisheries, with a mean of 33%. But the combined analysis of catch distribution for all FC brood years, 1973 to 1976, results in the following calculated means: Alaskan fisheries, 17%; Canadian fisheries, 38%; Washington and Oregon fisheries combined, 6%; Quinault terminal fishery, 32%; and QNFH escapement, 6%. A major portion of the average group of FC released from QNFH is harvested by the combined non-terminal fisheries annually. This not only impacts the relative harvest size of the terminal fishery in Quinault River, but also reduces the potential number of spawners that can return to QNFH.

Table 6. Distribution of QNFH FC adults caught in all fisheries, presented as percentage of total, by CWT group. From data files of WDF, QDNR, and QNFH.

Brood Year 19-	CWT Code	Alaska	Canada	WA/OR	Terminal	QNFH	Total %	Total No.
74	14-4-2	26	34	5	29	6	100	415
74	14-5-2	24	18	0	47	11	100	45
74	14-6-2	44	22	2	28	4	100	1003
74	14-14-2	46	21	0	28	5	100	78
75	14-3-10	26	32	0	32	10	100	31
75	14-4-10	10	46	5	34	5	100	312
75	14-5-10	14	29	2	45	10	100	244
75	14-6-10	7	30	0	44	19	100	54
75	14-7-10	10	62	0	18	10	100	39
75	14-8-10	6	31	12	49	2	100	49
76	5-35-1	9	37	8	38	8	100	415
76	5-36-1	8	29	0	63	0	100	38
	Mean	19	33	3	38	8	100	227

Information on Washington ocean fishing effort and harvest of chinook has been summarized by the Pacific Fishery Management Council (PFMC) in the 1983 proposed management plan (Pacific Fishery Management Council 1983). Since 1971, a general trend of decrease in chinook ocean harvest and fishing effort is apparent from the data. Table 7 presents PFMC summary data for Washington troll (including Indian troll) chinook catch and effort. The general trend has been reduction in catch and effort, until 1982. Effort continued to drop in 1982, but catch increased by about 39%. Effort has been decreasing, primarily due to the effects of increasing Indian treaty allocations. Catch increased in 1982. One factor causing this increase was the fleet's unexpected response to tightened restrictions on total days that fishing was permitted. The average boat apparently fished longer hours within days and was less selective about which days it fished than it had been previously.

The most pertinent area to focus attention, with regard to ocean catch and fishing effort's relation to Quinault FC return, is guided by the combined CWT return data. This data indicates that 38% of QNFH FC were harvested by the Canadians while 17% was taken by Alaskan fisheries. Chinook catch and effort in the Canadian and southeast Alaskan ocean troll fisheries for the years 1972 to 1981 are presented in figures 1 and 2, respectively (WDF) 1983). The curves for fishing effort, unfortunately, can only be associated with the chinook catch curves in a general sense because the effort information reflects days fished for the combined species chinook, sockeye, coho and pink. In the following discussion it is assumed that level of fishing effort was relatively consistent over time for a respective effort curve.

Table 7. Washington commercial troll chinook catch and effort since 1971. From Pacific Fishery Management Council, 1983.[a]

Year(19-)	Effort (Days Fished)	Chinook Catch
71-75		272,500
73-75	53,400	
76	60,200	353,700
77	54,400	231,600
78[b]	41,400	145,500
79[b]	41,700	132,400
80[b]	26,900	128,200
81[b]	27,900	113,500
82[b]	19,100	157,600

[a] Includes Indian troll catch and effort, and excludes Washington landings from other state's waters.

[b] Preliminary.

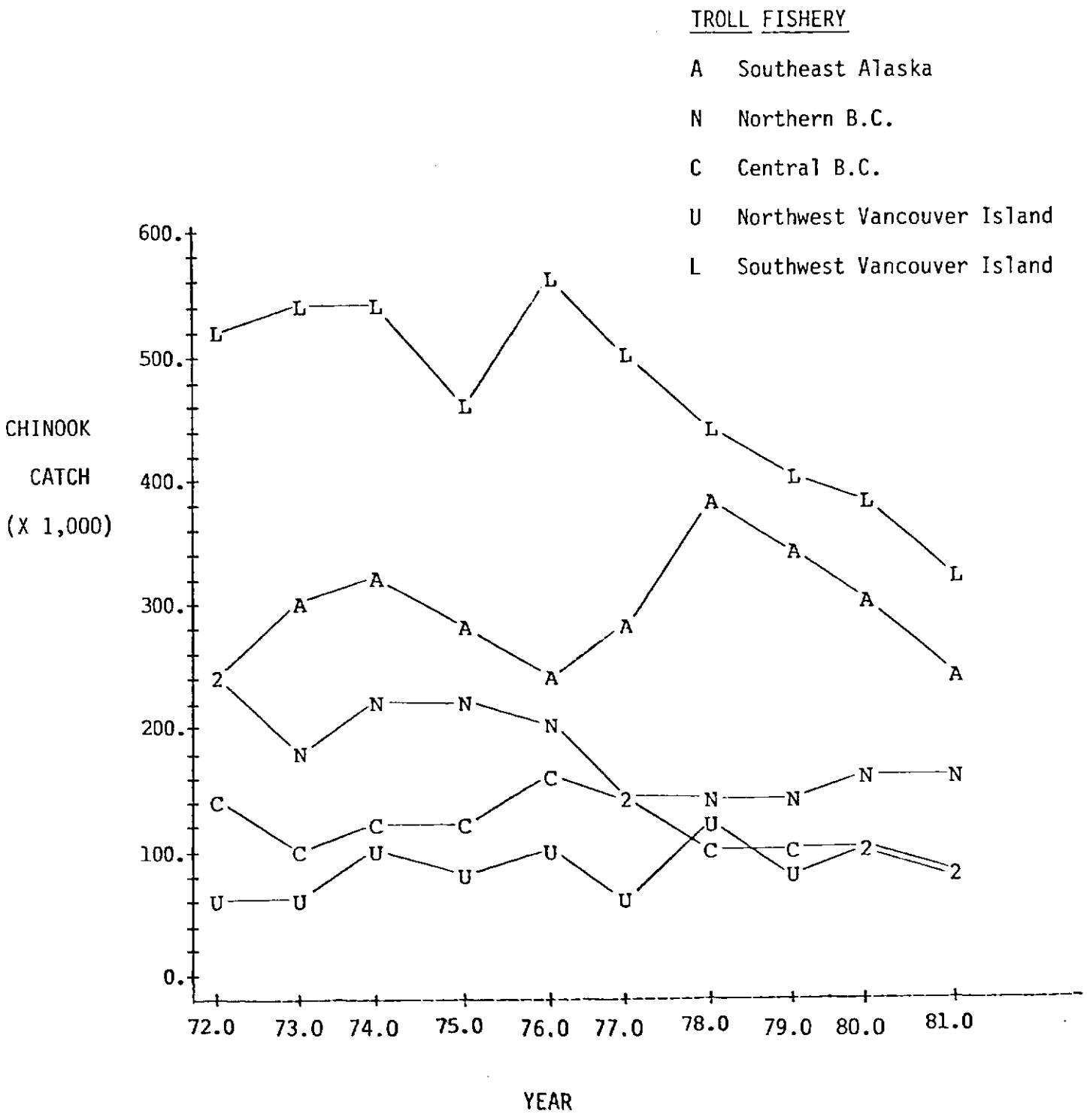
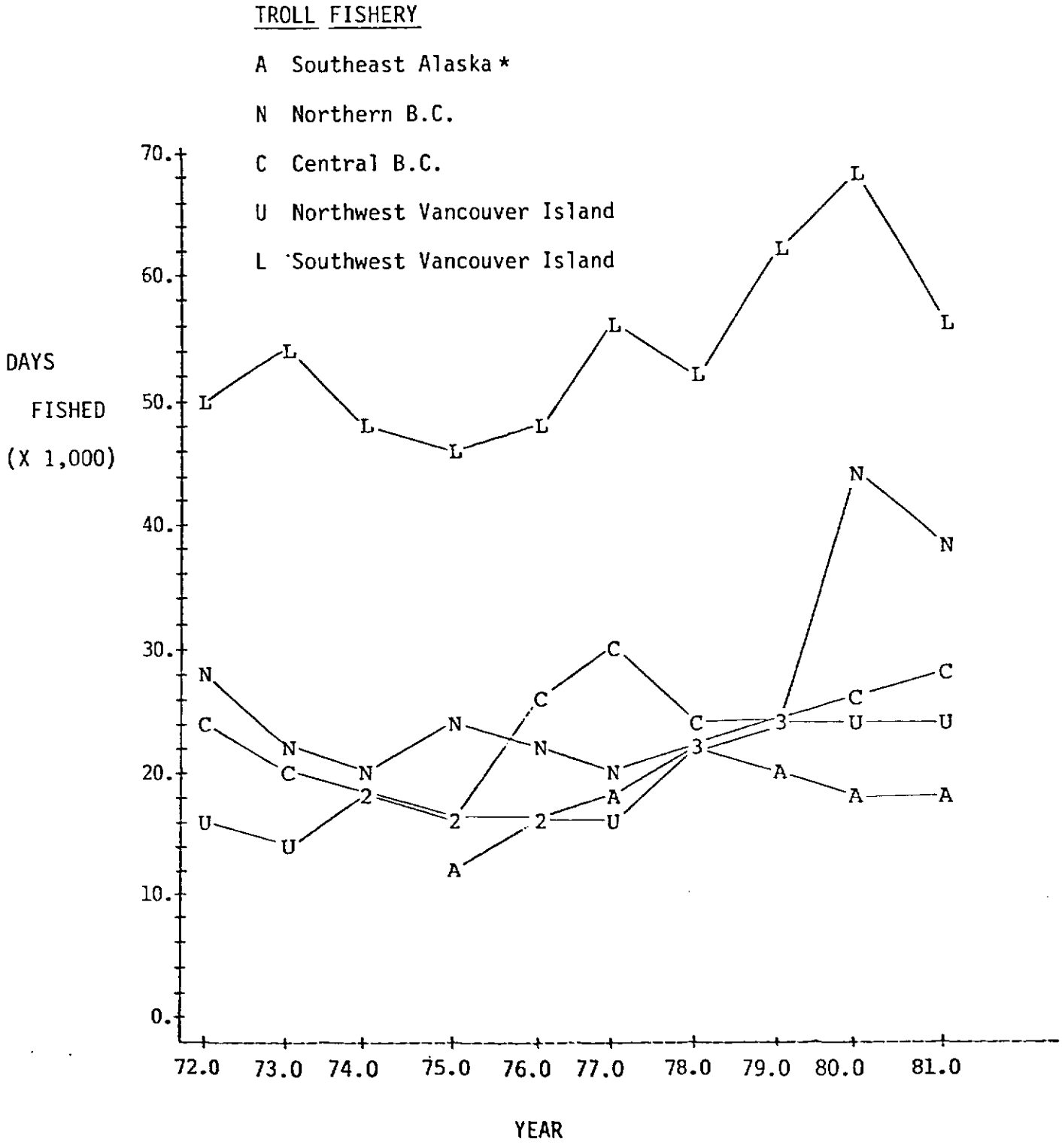


Figure 1. Total catch of chinook in southeast Alaskan and Canadian troll fisheries. From WDF data files(1983).



* Alaskan data is for thousands of landings.

Figure 2. Total annual troll effort for chinook, coho, sockeye and pink fishing. From WDF data files(1983).

Components of the Canadian troll fishery are displayed separately as southwest Vancouver Island ("L"), Northwest Vancouver Island ("U"), central British Columbia ("C"), and northern British Columbia ("N"). The southeast Alaskan troll fishery is displayed as "A". In figure 2, for convenience of comparison, the southeast Alaskan effort is displayed with the Canadian component efforts, however, while the Canadian effort is scaled as thousands of days fished, the Alaskan effort is actually thousands of boat landings (data for days fished is not available). As with the Canadian effort curves, the Alaskan curve reflects fishing effort on chinook, sockeye, coho and pink salmon. In comparing figures 1 and 2 the most important observation to be made is that during this time period trolling effort in both Alaskan and Canadian fisheries was generally increased while chinook catch generally decreased or remained about the same. When combined annual catch for southeast Alaska and all Canadanian trolling is compared to annual Quinault net catch (table 3) for respective years, one sees that a general trend of Quinault increase occurred while ocean catch was declining. There were, however, numerous factors effecting both the tribal and ocean catch rates, and it is probably not reasonable to conclude there was a direct response in chinook returned to Quinault River as a result of declining catch in ocean fisheries. Future trends in combined Alaskan and Canadian ocean harvest of chinook can be expected to continue to impact harvest opportunity for the Quinault fishery.

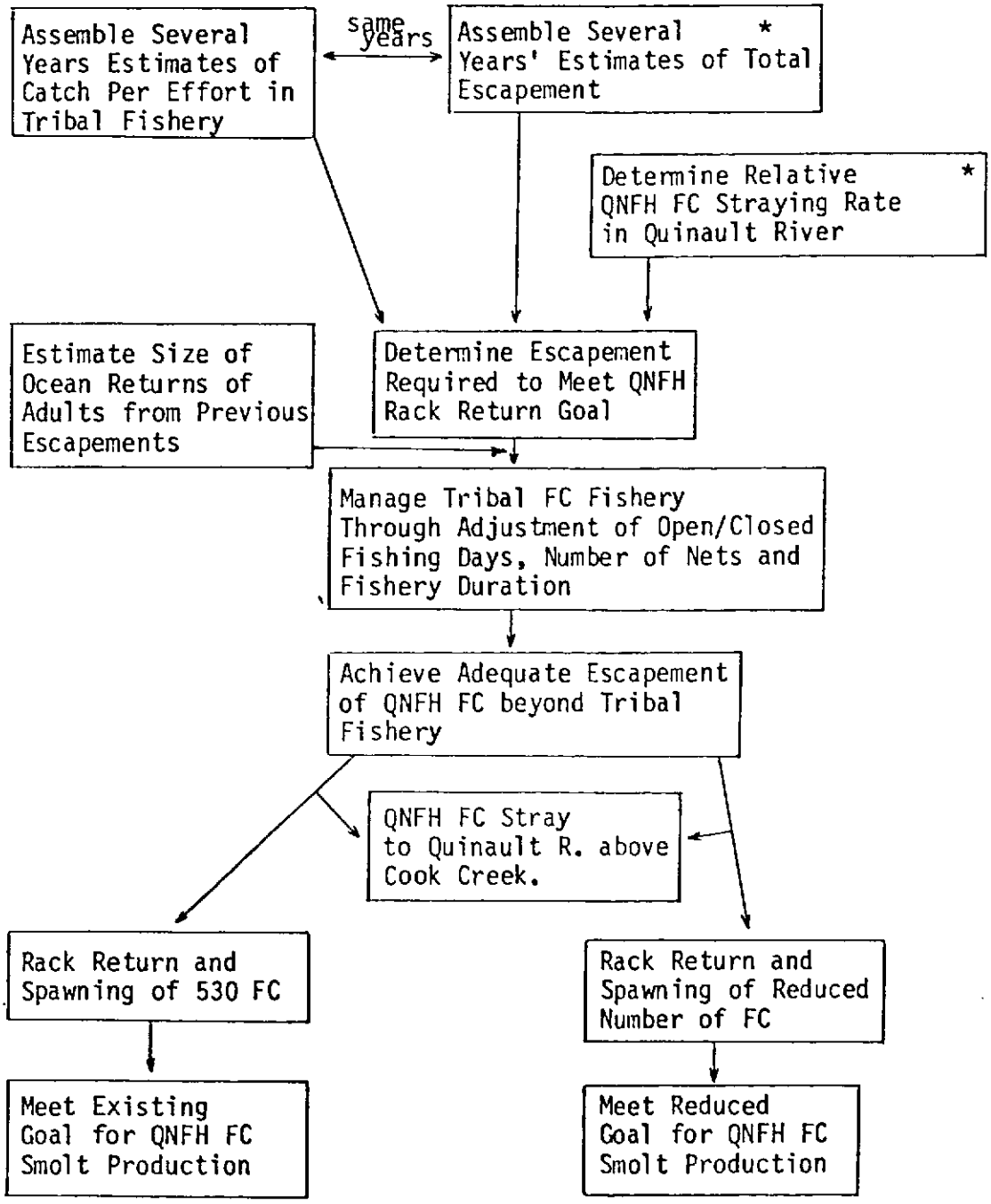
As for the immediate future, according to the Pacific Fishery Management Council (1983), coastal hatchery chinook are expected to return at levels similar to those of recent years. Natural coastal stocks, however, are expected to return at reduced levels due to the effects of winter floods in 1979 and 1980. The Quinault harvest of mixed hatchery stocks and a reduced wild run this year could in turn contribute to a reduced QNFH brood return.

Management of the Terminal Fishery

The inability of the QDNR to accurately estimate escapement has required that they make certain assumptions on: past total FC run sizes; past exploitation rates; and wild stock escapements. Based on such assumptions, and estimates of anticipated adult returns, estimates of harvestable surplus are then calculated annually. This procedure, combined with the high variability of annual ocean interception, and no opportunity to guide rate of harvest by in-season prediction, results in virtual inability to ensure adequate escapements. Suspected high rates of straying QNFH origin spawners to the Quinault River above Cook Creek further reduces the ability to predict the number of spawners returning to QNFH.

The virtual impossibility of obtaining a full series of aerial spawner/redd surveys over the duration of any spawning run denies any opportunity to develop accurate escapement estimates. It appears that a significant portion of QNFH FC have a tendency to stray and spawn in the Quinault River above Cook Creek (source, QDNR data files). Escapement and Quinault River straying rate estimates are essential to QNFH FC run management. Figure 3 diagrams the sequence for a step-by-step approach to reaching the QNFH FC broodstock goal. Until accurate escapement estimation is possible the broodstock problem will remain, given the present management priorities.

Figure 3. Research and management sequence for meeting QNFH broodstock goal.



* Research methodology/cost may be prohibitive.

A new approach, and most likely an expensive one, is needed. Intensive radio tagging and tracking may be required to determine straying. Several years of data from intensive dart tagging may also be required to determine the terminal fishery's exploitation rate. Such measures will be essential to solving the problem of correctly managing FC in the Quinault River.

SUMMARY

Review and analysis of the events and data from the 1982 QNFH FC spawning run, and related information from previous years, permits the following observations:

(a) the QNFH FC production goal was again not met in 1982; the shortfall was about 375 females and 370 males;

(b) general observations of the 1982 FC spawning run indicate there was an underescapement beyond the tribal fishery;

(c) CWT recoveries in all fisheries indicate nearly twice as many QNFH origin FC are harvested during an average year in the combined ocean fisheries as in the Quinault terminal fishery;

(d) the depressed level of FC smolt releases from the continual shortfall of broodstock can only be expected to continue in future years; as a result QNFH FC contribution to all fisheries will remain correspondingly low;

(e) it is unlikely that the existing FC smolt production goal can be met in the near future, given the new restriction on importing eggs, and the factors of run exploitation and fish straying;

(f) a trap for Cook Creek broodstock should not be used unless there is data to substantiate that a significantly increased spawning run has escaped the Quinault fishery;

(g) operation of the broodstock trap will require a considerable investment of man-days to insure success;

(h) use of morpholine as a chemical attractant for FC in spawning migration deserves consideration;

(i) the combined recoveries from CWT FC from QNFH, brood years 1973 to 1976, indicate that use of coastal broodstocks and delayed hatchery release result in increased survival to adult size;

(j) future trends in combined Alaskan and Canadian ocean harvest of chinook can be expected to impact harvest of FC in the Quinault fishery;

(k) the inability of the QDNR to accurately estimate past escapements will continue to hinder their ability to assure adequate escapements in the future, other than by trial and error fishery adjustments;

(l) a radio tagging study of distribution above the fishery may be the only realistic solution to the question of mainstem straying of QNFH returned spawners.

RECOMMENDATIONS

The preceding results, discussion and conclusions form a basis for new direction and new action in attempting to resolve the problem of inadequate FC broodstock. We offer the following recommendations for approaching that goal:

(a) the existing QNFH FC smolt production goal, 2.0 million eyed eggs should be reduced to a level that more reasonably reflects current QNFH capability and limitations;

(b) the unfinished spawning building at QNFH should be completed and used to improve spawning success and efficiency;

(c) the present policy of using only Cook Creek run FC as brood stock should be adhered to in the future;

(d) the present objective of delaying release of reared FC should be continued and, as improvements or changes in the facility permit, should be expanded to as many fish as possible;

(e) construction of two FC rearing ponds adjacent to QNFH would improve survival, increase production efficiency and should be seriously considered for future hatchery expansion;

(f) a trial FC tribal fishery closure during statistical weeks 32 through 36 should be implemented to determine what effect occurs in the QNFH broodstock capture;

(g) dart tagging of FC migrating into the Quinault River should be given high priority as a potential procedure for determining the degree of lower river milling that occurs and, moreover, as a means of determining the fishery's exploitation rate;

(h) serious consideration should be given to planning and initiating a radio tagging study to determine the relative distribution of QNFH FC spawners in the Quinault River and Cook Creek.

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APPENDIX
(Tables 1 - 12)

Table 1. Release and recoveries summary for 1974 brood fall chinook, tag code 14-4-2.[1]

Release Summary

Stock	Cook Creek
Release Purpose	Evaluate Timing, Contribution, Stock
Tagged releases	25,228
Size at release	18.2/lb
Date of release	08-30-75
Approximate total release	143,165

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	95
Expanded catch	404
Hatchery escapement	23
Total expanded recoveries	427
% survival	1.69
Age composition (% of total expanded recoveries)	
III	34.9
IV	52.0
V	11.9

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 2. Release and recoveries summary for 1974 brood fall chinook, tag code 14-5-2.(1)

Release Summary

Stock	Cook Creek
Release purpose	Evaluate timing, Contribution, Stock
Tagged releases	14,634
Size at release	52/lb
Date of release	06-26-75
Approximate total release	145,970

Recoveries Summary (Ages III,IV,V)

Total observed recoveries(2)	11
Expanded catch	37
Hatchery escapement	6
Total expanded recoveries	43
% survival	0.29
Age composition (% of total expanded recoveries)	
III	30.2
IV	55.8
V	13.9

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 3. Release and recoveries summary for 1974 brood fall chinook, tag code 14-6-2.[1]

Release Summary

Stock	Cook Creek X Willapa
Release purpose	Evaluate Timing, Stock
Tagged releases	31,243
Size at release	22.4/lb
Date of release	08-30-75
Approximate total release	170,860

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	123
Expanded catch	714
Hatchery escapement	36
Total expanded recoveries	750
% survival	2.4
Age composition (% of total expanded recoveries)	
III	20.9
IV	70.4
V	8.7

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 4. Release and recoveries summary for 1974 brood fall chinook, tag code 14-14-2.[1]

Release Summary

Stock	Willapa X Cook Creek
Release purpose	Evaluate Stock
Tagged releases	20,294
Size at release	60/lb
Date of release	06-26-75
Approximate total release	181,200

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	15
Expanded catch	56
Hatchery escapement	5
Total expanded recoveries	61
% survival	0.3
Age composition (% of total expanded recoveries)	
III	29.5
IV	42.6
V	27.9

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 5. Release and recoveries summary for 1975 brood fall chinook, tag code 14-3-10.[1]

Release Summary

Stock	Cook Creek
Release purpose	Evaluate Timing, Stock
Tagged releases	13,744
Size at release	45/lb
Date of release	06-29-76
Approximate total release	274,320

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[1]	4
Expanded catch	18
Hatchery escapement	3
Total expanded recoveries	21
% survival	0.15
Age composition (%of total expanded recoveries)	
III	4.8
IV	76.2
V	19

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 6. Release and recoveries summary for 1975 brood fall chinook, tag code 14 4 10.[1]

Release Summary

Stock	Cook Creek
Release purpose	Evaluate Timing, Stock
Tagged releases	15,203
Size at release	23.3/lb
Date of release	08-02-76
Approximate total release	146,000

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	52
Expanded catch	225
Hatchery escapement	14
Total expanded recoveries	239
% survival	1.57
Age composition (% of total expanded recoveries)	
III	66.9
IV	27.6
V	5.4

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 7. Release and recoveries summary for 1975 brood fall chinook, tag code 14-5-10.[1]

Release Summary

Stock	Cook Creek X Willapa
Release purpose	Evaluate Timing, Stock
Tagged releases	18,475
Size at release	45/lb
Date of release	06-29-76
Approximate total release	390,200

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	36
Expanded catch	140
Hatchery escapement	25
Total expanded recoveries	165
% survival	0.89
Age composition (% of total expanded recoveries)	
III	49.7
IV	41.8
V	8.5

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 8. Releases and recoveries summary for 1975 brood fall chinook, tag code 14-6-10.[1]

Release Summary

Stock	Cook Creek X Willapa
Release purpose	Evaluate Timing, Stock
Tagged releases	17,377
Size at release	45/lb
Date of release	08-02-76
Approximate total release	106,885

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	6
Expanded catch	24
Hatchery escapement	10
Total expanded recoveries	34
% survival	0.19
Age composition (% of total expanded recoveries)	
III	32.3
IV	58.8
V	8.8

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 9. Release and recoveries summary for 1975 brood fall chinook, tag code 14-7-10.[1]

Release Summary

Stock	Cook Creek x Nemah
Release purpose	Evaluate Timing, Stock
Tagged releases	14,445
Size at release	45/lb
Date of release	06-29-76
Approximate total release	243,790

Recoveries Summary (Ages III,IV,V)

Total observed recoveries[2]	7
Expanded catch	23
Hatchery escapement	4
Total expanded recoveries	27
% survival	0.19
Age composition (% of total expanded recoveries)	
III	74.1
IV	25.9
V	0.0

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 10. Release and recoveries summary for 1975 brood fall chinook, tag code 14-8-10.(1)

Release Summary

Stock	Cook Creek X Nemah
Release purpose	Evaluate Timing, Stock
Tagged releases	14,601
Size at release	23.3
Date of release	08-02-76
Approximate total release	107,620

Recoveries Summary (Ages III,IV,V)

Total observed recoveries(2)	10
Expanded catch	30
Hatchery escapement	1
Total expanded recoveries	31
% survival	0.21
Age composition (% of total expanded recoveries)	
III	71
IV	19.3
V	9.7

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 11. Release and recoveries summary for 1976 brood fall chinook, tag code 5-35-1.[1]

Release Summary	
Stock	Deschutes X Nemah
Release Purpose	Evaluate Contribution, Stock
Tagged releases	184,453
Size at release	47.8/lb
Date of release	07-13-77
Approximate total release	2,125,045

Recoveries Summary (Ages III, IV)	
Total observed recoveries[2]	50
Expanded catch	196
Hatchery escapement	29
Total expanded recoveries	225
% survival	0.12
Age composition (% of total expanded recoveries)	
III	53.3
IV	46.7

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.

Table 12. Release and recoveries summary for 1976 brood fall chinook, tag code 5-36-1.[1]

Release Summary

Stock	Cook Creek
Release purpose	Evaluate Contribution, Stock
Tagged releases	8,816
Size at release	35.6/lb
Date of release	07-21-77
Approximate total release	99,935

Recoveries Summary (Ages III, IV)

Total observed recoveries[2]	4
Expanded catch	14
Hatchery escapement	0
Total expanded recoveries	14
% survival	0.16
Age composition (% of total expanded recoveries)	
III	42.8
IV	57.1

(1) data sources: FAO files, WDF computer files, and QDNR files.

(2) excludes hatchery escapement.